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LIPID DEPOSITION IN THE HOUSE SPARROW AND RED-WINGED BLACKBIRD

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Abstract

In Central Michigan the mean fat to dry-lean weight ratios of juvenal and adult House Sparrows and Red-winged Blackbirds ranged from 0.09 to 0.35 during the summer and fall of 1973. The lipid index of adults was lowest during the breeding season and highest in the fall. Female red-wings migrated by early September shortly after completion of the postnuptial molt with no apparent increase in fatness. In late autumn other red-wings began premigratory fattening and increased their fat to dry-lean index from 0.16 in late October to 0.35 in mid-November. The sparrow fat index increased gradually from 0.09 early in the season to 0.17 in November.

Odum (1960), Caldwell et al. (1964), and Johnston (1966) have stated that some avian species begin migration in a relatively lean state and gradually increment their fat reserves through hyperphagia as they move toward their spring breeding areas or fall wintering grounds. In contrast, nonmigratory species presumably do not exhibit any appreciable vernal or autumnal increase in body fats.

In the present study amounts of whole body lipid values were compared between the migratory Red-winged Blackbird (*Agelaius phoeniceus*) and the nonmigratory House Sparrow (*Passer domesticus*). Whole body lipids were measured through the summer and into the fall migratory season.

Methods

Collections of the two species were made in Isabella County, Michigan, from May into December 1973 with a shotgun and number nine shot. The

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blackbirds ($N = 130$) were taken from both upland and marshland habitats and the sparrows ($N = 88$) were collected near human dwellings or farm outbuildings. All specimens were weighed and then frozen until the time of analysis.

Skull ossification was used to separate birds of the year from older birds (Nero, 1951; DeHaven et al., 1974). Each specimen was dissected, the sex determined, and the gut and crop contents removed before fat extraction. The fat extraction technique involved the use of a food blender with petroleum ether and ethyl alcohol solvents and is described elsewhere (Matson and Caldwell, Kirtlandia, No. 26).

Results

Fledged immature House Sparrows were of a smaller body mass than the adults. The mean dry-lean weight of the fledglings at 6.5 ± 0.12 (1 standard error of the mean) grams was significantly smaller than the adults 7.61 ± 0.06 grams ($P < 0.01$). However, since total body fats averaged 0.96 grams for each group, the immature birds had a higher fat to dry-lean ratio (0.15) than did the adults (0.12) because of a smaller dry-lean body mass ($P < 0.05$).

A fat to dry-lean comparison in the red-wing is more complex because this species exhibits sexual dimorphism and premigratory fattening. The females average 11.18 grams of dry-lean weight and were smaller than the males at 18.68 grams ($P < 0.01$).

With regard to age differences, immature female red-wings were significantly smaller in dry-lean body mass at 10.17 grams than adult females (11.49 grams, $P < 0.05$), as would be expected. Likewise, immature males at 16.70 grams were smaller than the adult males at 19.34 grams ($P < 0.01$). There was likewise a tendency for immatures to be more obese than the adults. During the summer and early fall months the 0.18 fat index of immature red-wings of both sexes combined was significantly higher than the 0.14 value found in the adults ($P < 0.01$). Just prior to migration, the ratio of fat to dry lean of the immatures rose to 0.29 but there was no difference from the ratio value of the adult birds at 0.27 ($P > 0.50$).

Adult House Sparrows in the early part of the nesting season had a fat index of 0.09 with a variance of only 0.0002 (Fig. 1). In the middle and later parts of the nesting season the variance was much larger ($S^2 = 0.003$), but the mean index (0.12) had not risen significantly ($P < 0.10$). By late October, after the postnuptial molt, the index had increased to 0.17 while the variance had decreased to 0.0005. The postnuptial fat index was markedly higher than the early nesting season index ($P < 0.001$). The fat index of the immatures averaged 0.14 throughout most of the nesting season, but in early October it declined to 0.11 before increasing to the same value (0.17) as found in the adults in late October.

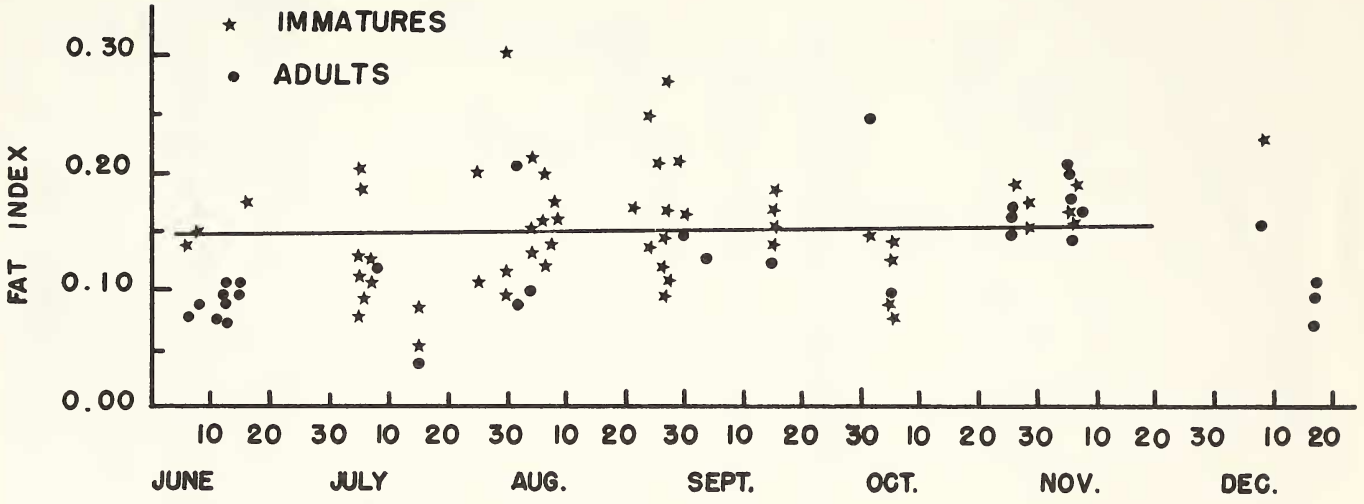

Fig. 1. Changes in the fat index of adult and juvenal House Sparrows in Central Michigan during the summer and fall of 1973.

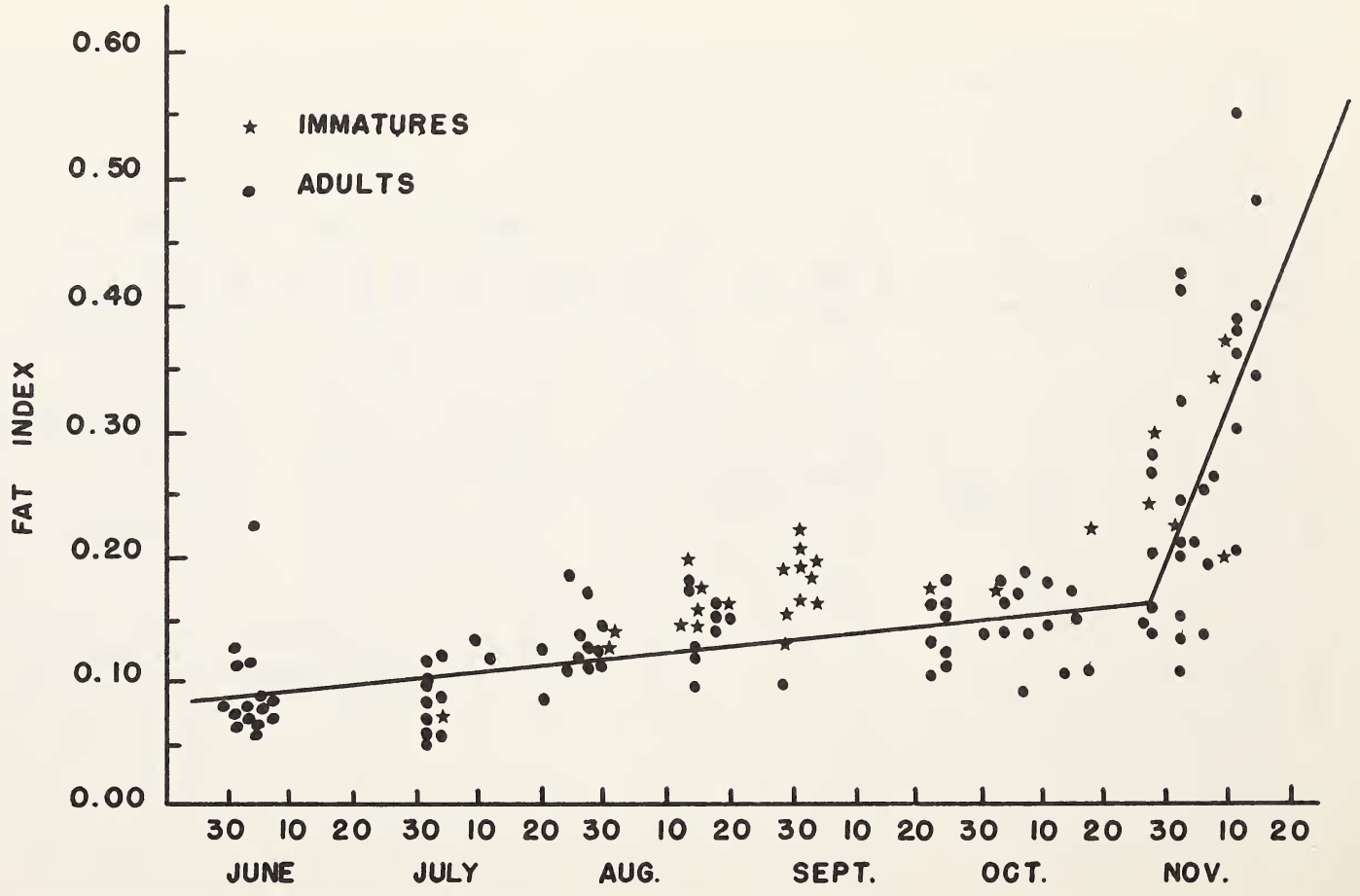

Fig. 2. Changes in the fat index of adult and juvenal Red-winged Blackbirds on their breeding grounds in Central Michigan during the summer and fall of 1973.

The 0.09 fat index for adult red-wings during the June and early July nesting season (Fig. 2) was almost identical with the index of the adult House Sparrows ($P > 0.50$). Then by 15 August the red-wing index had risen to 0.14, where it remained relatively constant until the start of the fall premigratory fat build-up beginning about 27 October. The variance of the index throughout the above mentioned interval was moderate ($S^2 = 0.0009$). Then, between 27 October and 11 November, the index rose rapidly from 0.16 to 0.35. The linear regression equation for the increase of fat in grams per day for adult Red-winged Blackbirds during this period of rapid premigratory fattening is $Y = 0.27X - 36.78$ ($S^2 = 0.009$). In other words, 0.27 grams of fat were stored per day for approximately 15 days, at which time the migrants departed.

TABLE 1

Comparison of Major Body Components of Juvenal and Adult House Sparrows and Red-winged Blackbirds

Age	*Mean Dry-lean Weight (Grams)*	*Fat (Grams)*	*Fat Index*	*Water (Grams)*	*Water Index*
		House Sparrow			
Juvenal	6.5	1.0	0.2	20.1	3.1
Adult	7.6	1.0	0.1	21.0	2.8
		Red-winged Blackbird			
Juvenal	15.1	3.1	0.2	42.2	2.8
Adult	17.3	3.0	0.2	43.1	2.5

The data that have been analyzed in this study are linear rather than discrete in nature. For summary purposes, however, a set of discrete data in tabular form is valuable for reference (Table 1). Notice in Table 1 that water is also a variable body component. The water index (water weight divided by dry-lean weight) is lowest in the adults. The 3.1 index of immature sparrows is higher than that of the immature red-wings (2.8) and other avian species for which water indices have been determined. For example, Ricklefs (1967) found the index of fledgling Barn Swallows to be about 2.3 and for Dickcissels it is about 2.3 (Zimmerman, 1965). The value for adult House Sparrows (2.8) and adult Red-winged Blackbirds (2.5) is quite close to the index of 2.6 in Long-billed Marsh Wrens (Kale, 1965).

Discussion

Both House Sparrows and adult Red-winged Blackbirds were relatively lean with a low fat index (0.09) and low variance during the early part of the nesting season (Figs. 1 and 2). The low index and variance in the adult is probably related to a uniformly high expenditure of energy in nesting activities once breeding and caring for the young begins. Once the first clutch has been raised, however, the variance increases as some adults increase their lipid reserves. Increased variance in the ratio of fat to dry-lean during the middle and latter part of the House Sparrow nesting season should be expected since not all adult birds breed the same number of times (Weaver, 1943) nor is the second breeding as synchronized as the first breeding. Folk and Novotny (1970) in their year-long study of the body weight of the House Sparrow noted that the body weight decreased in May. They attributed this loss to parental care for the young of the first clutches. In June, however, they found that the body weight increased in accordance with the production of sexual products for the next breeding. It seems that in addition to the increase in sexual products our data indicate that some of the body weight increase is due to the increase in fat reserves following the period of parental care for the young, especially in the individuals that breed only once during the season. Similarly, the index of the red-wings increased after the period of parental care ended in early July.

By late October, after the breeding season was finished and the postnuptial molt had been completed, the ratio of fat to dry-lean of the House Sparrow was again uniform. Folk and Novotny (1970) found that by October the body weight of the male and female components of their sample had risen significantly over that of the birds taken during the breeding season. They attributed this increase in body weight to the increase of fat prior to the winter months. This study indicates that their proposal is correct and that House Sparrows do indeed increase their fat reserves prior to the winter season. Note that the 5 House Sparrows collected in December were not involved in the data analysis or interpretation since they were collected after the red-wings had departed for the winter.

Molting requires energy and could result in a drop in the fat index if food intake is rather low. The effect of the postnuptial molt on the fat index of the adult House Sparrow is uncertain. Adults were found replacing flight feathers from about the middle of August through the latter part of October. The data on adults during this period are, however, too few to make any meaningful analysis.

Adult red-wings were observed molting from late July into the early part of October. A statistical comparison of the fat index between molting adults and

nonmolting adults reveals no significant differences between the two groupings ($P<0.40$). Unfortunately, only 4 adult birds were observed not molting during this period. Likewise, the sample number ($N=2$) of nonmolting immatures was too small to warrant a comparison with molting immatures.

It should be noted that after 1 September only two female red-wings were collected. Shortly after completing the postnuptial molt, both adult and immature females migrated to other areas. A comparison of the fat indices between the last two females collected in September (0.19) with the only two females collected in November (0.34) reveals that females found in the area late in the fall had increased their fat reserves considerably over those leaving earlier. The fat index of 0.34 found in the November females is comparable with the 0.27 value found in adult males during this premigratory fattening period. In other words, most female red-wings begin some form of migration early in the fall or late summer after completion of the postnuptial molt, and they do so without increasing their fat reserves to any appreciable degree. Yet those few females that are found in the area in the late fall increment their fat depots to levels equal with those of males, which normally migrate in November.

During the premigratory fattening period that began around 27 October the fat index of the Red-winged Blackbirds increased from 0.16 to 0.35, thus doubling in value from the summer period. The index values of 0.29 and 0.27 for immature and adult male red-wings during premigratory fattening were not significantly different ($P>0.50$). The equation expressing the relationship between the fat index and time during premigration for both age groups is $Y=0.01X-1.11$, where Y is the fat index and X is the number of the collection day based on 31 May as day one. In other words the ratio of fat to dry-lean weight increased 0.01 each day from 27 October to 14 November. Thus, as mentioned earlier, an average of 0.27 grams of fat were added to the lipid depot each day throughout the premigratory fattening period. For comparison, Morton et al. (1973) estimated the rate of fattening of transient White-crowned Sparrows (*Zonotrichia leucophrys gambelii*) as 0.3 grams per day. He also estimated the rate of fattening of captive *Zonotrichia leucophrys oriantha* to be about 0.1 grams per day for the few days following the molting period, and preceding the autumn migration. From the data in Table 1 of Norris et al. (1957) it is possible to calculate the rate of lipid accumulation of a transient flock of Ruby-throated Hummingbirds during a period of intense preflight fattening. The mean fat content increased from about 1.07 grams on 16 September to a value of 2.18 grams on 23 September. In other words, fat was deposited at a rate of 0.16 grams per day throughout a seven day period before the birds left the area. Of course the Ruby-throated Hummingbird, by virtue of its small size, does not need to accumulate as much fat as the red-wing. But for comparative

purposes it is interesting to note that the red-wing, which has a dry-lean weight 18 times that of a Ruby-throated Hummingbird, adds almost twice as much fat per day. It is important to realize that the premigratory fattening period of the red-wing lasts about 16 days in contrast to the amazingly short time of about 7 days in the transient Ruby-throated Hummingbird population studied by Norris.

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